DATA QUALITY SUMMARY REPORT FOR PM$_{2.5}$ NITRATE DATA COLLECTED BY SONOMA TECHNOLOGY, INC., DURING THE CALIFORNIA REGIONAL PM$_{10}$/PM$_{2.5}$ AIR QUALITY STUDY

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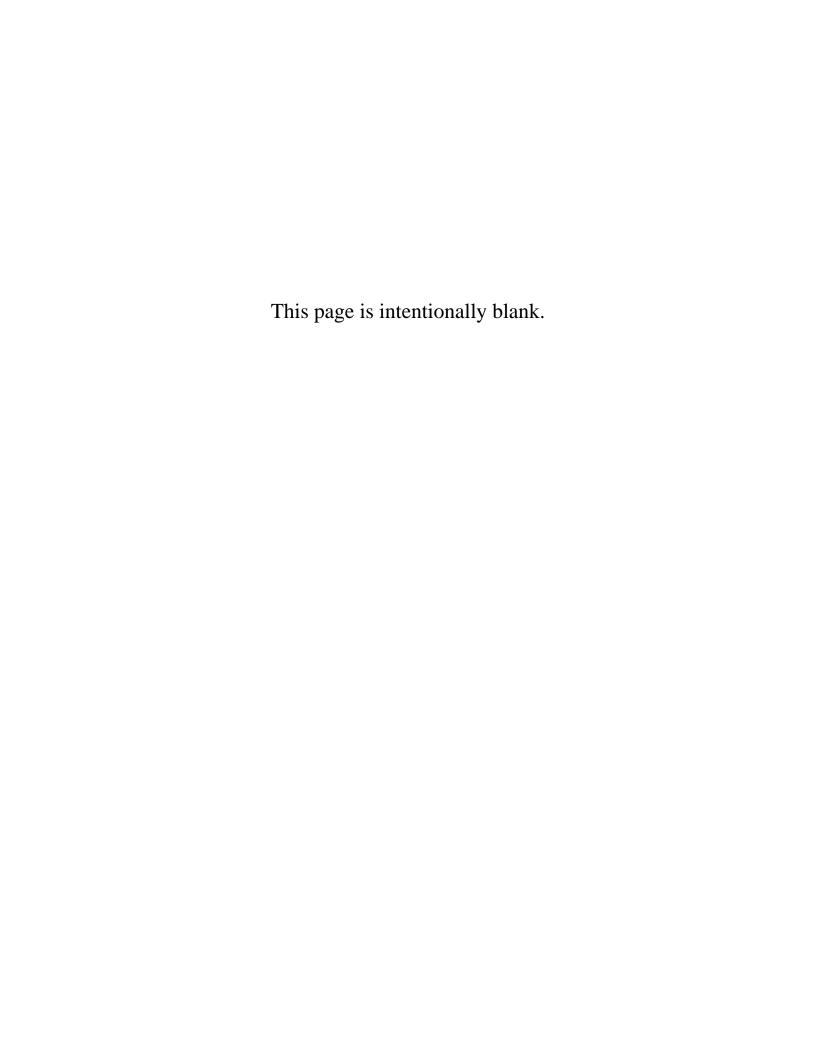**1001 "I" Street**
Sacramento, CA 95814
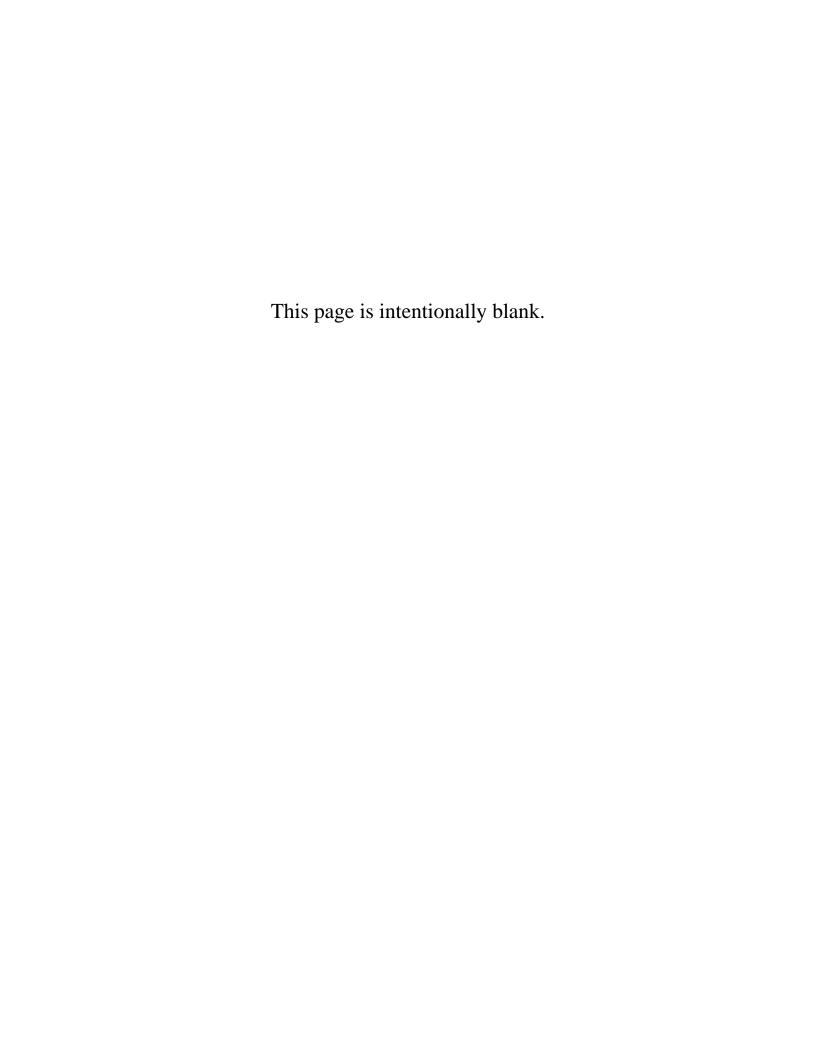
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1.   INTRODUCTION AND OBJECTIVES

The purpose of this Data Quality Summary Report is to provide data users with an understanding of the quality of nitrate (NO_3) data collected by Sonoma Technology, Inc. (STI) for the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study (CRPAQS). **Table J-1** summarizes the operating sites and times for sulfate concentration measurements during CRPAQS. This report provides summary information on data completeness, lower quantifiable limit (LQL), accuracy, and precision. The nitrate instrument measured $PM_{2.5}$ nitrate concentrations ($\mu g/m^3$) on a 10-minute basis. The 10-minute data were also averaged to 60-minute concentrations; both data sets were reported in the corresponding database and reports. Data completeness was calculated for all sites based on data delivered to ARB; the start date/time indicates the beginning of valid data, continuous until the stop date/time. Data validation suggested that all nitrate instruments performed similarly; thus, Angiola was used as a representative site to calculate LQL, accuracy, and precision for all nitrate monitors operated by STI in the study.

Table J-1.   Location and duration of nitrate measurements made by STI during CRPAQS.

Site	Start Date/Time	Stop Date/Time
Angiola Trailer	11/21/00 0:00 PST	3/2/01 9:20 PST
Angiola 100-m Tower	12/5/00 19:30 PST	3/2/01 9:20 PST
Bakersfield	11/15/00 12:30 PST	3/6/01 10:00 PST
Bethel Island	11/28/00 14:50 PST	2/6/01 11:30 PST
Corcoran	9/29/00 17:30 PST	11/14/00 23:40 PST
San Jose	11/9/00 10:10 PST	2/15/01 23:40 PST
Sierra Nevada Foothills	11/19/00 20:00 PST	2/6/01 4:10 PST
Walnut Grove	11/15/00 17:20 PST	2/13/01 13:40 PST
Walnut Grove Tower	11/17/00 14:00 PST	2/4/01 0:40 PST

Several other documents are available from which to obtain information about the CRPAQS field study and data processing. Sampling locations are described in Wittig et al. (2003). Quality control screening procedures are summarized by Hafner et al. (2003). Results of systems and performance audits and intercomparisons are provided by Bush et al. (2001).

The data quality objectives (DQOs) for nitrate from instrument specifications are shown in **Table J-2**. DQOs were not available for data completeness, accuracy, or precision. The LQLs for both 10- and 6-minute averages met the DQOs.

Table J-2.   Data quality objectives for nitrate data collected during CRPAQS.

Data Quality Metric	Objective
Lower Quantifiable Limit	$0.3 \ \mu g/m^3$

2. DATA COMPLETENESS

Data completeness for nitrate is shown in **Table J-3**. Data capture quantifies the percentage of total records received versus the number expected during the "period of operation" defined by the start and stop dates/times in Table J-1; the start date/time is the first instance of valid data, and the period of operation is continuous until the stop date/time. The number of valid data points is divided by the number of captured data points to calculate the data recovery. Validity is defined for this calculation as any data point that has a quality control flag of V0 (valid) or V1 (valid but comprised wholly or partially of below-MDL data). Details of data validation are included in Hafner et al. (2003).

Table J-3. Data completeness values for nitrate at each site.

Monitoring Site	Total No. of Records	No. of Expected Records	Percent Capture[a]	No. of Valid Records	Percent Recovery[b]	No. of Suspect Records	No. of Invalid Records	No. of Missing Records
Angiola Trailer (10-min)	14,601	14,601	100%	10,879	75%	2193	256	1273
Angiola Trailer (60-min)	2434	2434	100%	1799	74%	347	112	176
Angiola 100-m Tower (10-min)	12,468	12,468	100%	11,706	94%	0	55	707
Angiola 100-m Tower (60-min)	2079	2079	100%	1934	93%	7	46	92
Bakersfield (10-min)	15,970	15,970	100%	14,587	91%	3	23	1357
Bakersfield (60-min)	2663	2663	100%	2420	91%	3	38	202
Bethel Island (10-min)	10,061	10,061	100%	7964	79%	237	107	1753
Bethel Island (60-min)	1678	1678	100%	1299	77%	48	57	274
Corcoran (10-min)	6662	6662	100%	4720	71%	35	76	1831
Corcoran (60-min)	1111	1111	100%	820	74%	18	58	215
San Jose (10-min)	14,194	14,194	100%	11,179	79%	23	93	2899
San Jose (60-min)	2366	2366	100%	1823	77%	7	68	468

[a] % of capture = total number of records/expected records*100%
[b] % recovery = number of valid records/total number of records

Table J-3. Data completeness values for nitrate at each site.

Monitoring Site	Total No. of Records	No. of Expected Records	Percent Capture[a]	No. of Valid Records	Percent Recovery[b]	No. of Suspect Records	No. of Invalid Records	No. of Missing Records
San Jose (60-min)	2366	2366	100%	1823	77%	7	68	468
Sierra Nevada Foothills (10-min)	11,282	11,282	100%	8786	78%	1682	88	726
Sierra Nevada Foothills (60-min)	1881	1881	100%	1401	74%	294	87	99
Walnut Grove (10-min)	12,939	12,939	100%	10,861	84%	246	39	1793
Walnut Grove (60-min)	2157	2157	100%	1782	83%	32	57	286
Walnut Grove Tower (10-min)	11,297	11,297	100%	9233	82%	193	36	1835
Walnut Grove Tower (60-min)	1883	1883	100%	1497	80%	28	66	292

[a] % of capture = total number of records/expected records*100%
[b] % recovery = number of valid records/total number of records

All sites had a 100% data capture rate. Data recovery rates ranged from 71% (Corcoran, 10-minute) to 94% (Angiola 100-meter tower, 10-minute).

3.   LOWER QUANTIFIABLE LIMIT

The LQL is the lowest concentration in ambient air that can be measured when processing actual samples. Sources of variability that influence the monitored signal at low concentrations include instrument noise and atmospheric variability. As a measure of this variability, two times the standard deviation of selected 10-minute and 60-minute data was used to estimate the LQL for the 5-minute and 60-minute data, respectively. The selected data were collected during relatively stable periods with concentrations close to zero. This is a conservative estimate of the LQL because it includes the concentration variability of the ambient air. Six consecutive data values were used to compute the LQL for both the 10-minute and 60-minute data; atmospheric variation generally becomes too great after six hours to calculate a reasonable LQL.

The LQL is calculated as shown in Equation J-1. **Table J-4** shows the 10-minute and 60-minute LQL, as well as the specific data strings used to calculate the LQL. The LQLs for 10-minute and 60-minute data meet the DQO.

$$LQL \approx 2s = 2\sqrt{\frac{\sum (NO_3 - \overline{NO_3})^2}{N-1}}$$
(J-1)

where:

$\overline{NO_3}$ = mean nitrate concentration
N = number of measurements
σ = standard deviation

Table J-4. Time period used to calculate LQL, the LQL, and the corresponding mean nitrate concentration during the selected time period.

Type of data	Time Period Used in LQL Calculation	LQL (μg/m^3)	Mean (μg/m^3)
10-minute	2/13/01 20:50 – 21:50 PST	0.10	0.13
60-minute	2/11/01 12:00 – 18:00 PST	0.04	0.19

4.   ACCURACY

Calibration data for the nitrate instrument are not available because these instruments cannot be calibrated in a manner similar to instruments measuring gaseous speciation. Therefore accuracy calculations are beyond the scope of this report for this instrument.

5.   PRECISION

Precision can be measured for the nitrate instrument by evaluating the variance of nitrate concentrations during a period of low variability, where atmospheric influence on variability is assumed to be minimal. 10-minute and 60-minute data collected during periods of low variability, but when concentrations were well above the LQL, were selected. The precision was then evaluated by calculating the coefficient of variation (CV) during the period of low variability, as shown in Equation J-2.

$$\text{Pr ecision} \approx CV = \frac{\sigma_{measured}}{[\overline{NO_3}]_{measured}} \times 100\%$$
(J-2)

where:

$$\sigma_{measured} = \sqrt{\frac{\sum ([NO_3]_{measured} - [\overline{NO_3}]_{measured})^2}{N-1}}$$

J-4

All the nitrate concentrations in Equation J-2 refer to the concentrations measured during the selected time period. **Table J-5** shows the precision calculated for the representative site, Angiola.

Table J-5. Precision, the number of data points, time period, and mean of the data used to calculate the precision of the nitrate data at the representative site, Angiola.

Interval	No. of Data Points Used	Time Period	Mean ($\mu g/m^3$)	Precision
10-minute	11	11/23/00 02:00 – 03:50 PST	12.22	3.1 %
60-minute	6	2/19/01 14:00 – 20:00 PST	6.62	3.8 %

6.   REFERENCES

Bush D., Baxter R., and Yoho D. (2002) Final quality assurance audit report - California Regional PM$_{2.5}$/PM$_{10}$ Air Quality Study (CRPAQS). Prepared for San Joaquin Valleywide Air Pollution Study Agency c/o California Air Resources Board, Sacramento, CA, by Parsons Engineering Science, Inc., Pasadena, CA, June.

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